

REMARKS

The Examiner's Office Action mailed June 16, 2003, has been received and its contents carefully reviewed. In response to this Office Action, Applicants amended independent claim 1 and independent claim 6 to further distinguish the features and advantages of the present invention. For the reasons set forth in detail below, presently pending claims 1-3, 5-7, and 9 are believed to be in condition for allowance. Reconsideration of this application is respectfully requested.

Claims 1-3, 5-7, and 9 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Akahori et al. in U.S. Patent No. 6,218,299 (hereafter "Akahori") in view of Homma et al. in U.S. Patent No. 5,420,075 (hereafter "Homma"). For the reasons set forth in detail below, it is respectfully submitted that the rejection of these claims should be withdrawn.

Amended claim 1 recites a method for fabricating a semiconductor device, comprising the steps of depositing a fluorine-containing organic film on a semiconductor substrate using a material gas containing fluorocarbon as a main component in a reactor chamber of a plasma processing apparatus, and after the depositing step, densifying the fluorine-containing organic film by exposing the fluorine-containing organic film to a plasma of a rare gas including no fluorocarbon thereby heating the film in the same reactor chamber, where the fluorocarbon is C₅F₈, C₃F₆, or C₄F₆.

Akahori, in contrast, teaches a method for producing a semiconductor device characterized by creating a plasma from a pretreatment gas or hydrogen plasma-creating gas and applying this plasma to a surface upon which a fluorocarbon film is to be formed (see col. 2, lines 54-59). Akahori then teaches forming irregularities on the surface to be processed and creating a plasma from a film-forming gas, then forming a fluorocarbon film on the surface to be processed by the use of this plasma created by the pretreatment gas by interaction between microwave and magnetic field (see col. 2, lines 60-65). That is, Akahori teaches a step of depositing a fluorine-containing organic film using a material gas including

fluorocarbon as the main component. However, Akahori fails to disclose a step of densifying the fluorine-containing organic film by exposing the film to the plasma made from the rare gas.

In the instant application, amended independent claim 1 and amended independent claim 6 recite the inventive steps of 1) densifying the fluorine-containing organic film by exposing the fluorine-containing organic film to the plasma of the rare gas including no fluorocarbon thereby heating the film, and 2) exposing the fluorine-containing organic film to the plasma and heating the film, after depositing the fluorine-containing organic film in the reactor chamber of the plasma processing apparatus.

In amended claims 1 and 6, since the fluorine-containing organic film is heated by using the plasma derived from the rare gas including no fluorocarbon, which is an agent for depositing film, the fluorine-containing organic film can be densified.

Moreover, since in the present application the fluorine-containing organic film is exposed to the plasma in the same reactor chamber in which the fluorine-containing organic film is deposited, the number of process steps can be reduced, and the problem of particles depositing on the semiconductor substrate, when transferring the semiconductor substrate, can be prevented (see original application, starting on page 2, line 24).

The Office Action asserts that Akahori discloses densifying a fluorine-containing organic film using argon (i.e., Ar) (see p. 3, lines 1-2 of the Office Action mailed 06/16/2003). However, the plasma referred to in Akahori refers to the Ar gas plasma, *not* the film as being highly densified (see Akahori '299 patent, col. 7, lines 8-21). Akahori discloses, "[T]hat a stabilized plasma can be created by the use of Ar gas" (see col. 7, lines 19-21). Accordingly, in Akahori, an electron cyclotron resonance (ECR) plasma apparatus, which can generate high-density plasma, is used to generate the plasma (see col. 6, lines 17-27 and 28-34).

Akahori further discloses introducing the Ar gas and the $C_4F_8 + C_2H_4$ gas into the reactor chamber, and thereafter depositing the fluorine-containing organic film (CF film)

using the plasma derived from the above gases (see col. 6 , line 63 – col. 7 , line 2). In contrast, amended claims 1 and 6 of the present application recite that the fluorine-containing organic film is deposited using the material gas—including fluorocarbon as the main component—and thereafter expose the fluorine-containing organic film to the plasma of the rare gas including no fluorocarbon thereby heating the film. As such, the function of the plasma derived from Ar gas and the method in which it is prepared is completely different in the two inventions.

According to Akahori, the fluorine-containing organic film (CF film) is deposited by using the plasma derived from Ar gas including fluorocarbon. In the step of depositing the CF film, although the CF film is exposed to the Ar plasma and heated, this function is extremely limited. Moreover, the CF film deposited at the end of the depositing step taught by Akahori is mostly not exposed to the Ar plasma.

On the other hand, amended claims 1 and 6 of the present application recite that the fluorine-containing organic film is exposed to the plasma of the rare gas including no fluorocarbon after the step of depositing the fluorine-containing organic film, thereby purposely and actively heating the CF film. Hence, in the step of exposing the CF film to the plasma of Ar gas, deposition of the fluorine-containing organic film does not occur, and the CF film is certainly densified.

Further, Akahori fails to teach photoresist patterning the metal lines as recited in claims 6, 7, and 9 of the present application.

However, the Office Action asserts that Homma teaches a method of forming a semiconductor device, which includes forming metal lines by known patterning methods such as with a photoresist masking and etching the conductive metal with plasma reactive ion etching and filling the gap between the metal lines with an insulating layer (see col. 4, starting at line 1). The Office Action also asserts at the time the invention was made, it would have been an obvious matter to a person of ordinary skill in the art to use modify the

teaching of Akahori with photoresist patterning and etching the metal with plasma etching to form metal lines as suggested by Homma.

Homma, however, merely discloses a step of depositing an insulating film between wirings, and using a photoresist mask and etching to form a pattern of metal wiring. Homma fails to disclose the step of densifying the fluorine-containing organic film by exposing the fluorine-containing organic film to the plasma of the rare gas including no fluorocarbon thereby heating the film, or the step of exposing the fluorine-containing organic film to the plasma and heating the film, after depositing the fluorine-containing organic film in the reactor chamber of the plasma processing apparatus.

The claimed method as recited in claims 1-3, 5-7, and 9 differs markedly from the cited references as outlined above especially with regard to the Ar gas plasma being highly densified and the film being highly densified. As such, Applicants respectfully submit that the rejection of claims 1-3, 5-7, and 9 under 35 U.S.C. § 103(a) is improper.

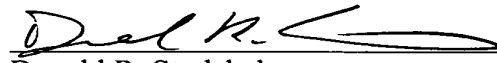
For the reasons outlined above, Applicants respectfully requests that the rejection of independent claims 1 and 6 under 35 U.S.C. § 103(a) be reconsidered and withdrawn. Similarly, Applicants respectfully requests that the rejection of dependent claims 2, 3 and 5 of amended independent claim 1, and dependent claims 7 and 9 of amended independent claim 6 under 35 U.S.C. § 103(a) also be reconsidered and withdrawn.

CONCLUSION

Therefore, in view of the foregoing Amendments to independent claims 1 and 6, it is respectfully requested that the rejections of record be reconsidered in view of the Amendment and be withdrawn by the Examiner. It is further requested that claims 1-3, 5-7, and 9 thus be allowed and that the application be passed to issue.

Should the Examiner believe a conference would be of benefit in expediting the prosecution of the instant application, he is hereby invited to telephone counsel to arrange such a conference.

Respectfully submitted,


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